

How “Smart” is the Interactive Whiteboard for Ohio Mathematics Teachers?

Alyssa M. Hoslar, Strongsville High School <amhoslar@gmail.com>
Daniel J. Brahier, Bowling Green State University <brahier@bgsu.edu>



Alyssa M. Hoslar is a mathematics teacher at Strongsville High School in Northeast Ohio. She graduated from Bowling Green State University with a B.S. in Integrated Mathematics Education for grades 7 through 12 in May of 2008. Daniel J. Brahier is a professor at Bowling Green State University in Ohio. He teaches mathematics methods courses for the early and middle childhood and the AYA program. He also teaches eighth grade mathematics at St. Rose School in Perrysburg, Ohio.



National Council of Teachers of Mathematics listed technology as one of the six basic Principles of a quality mathematics program (NCTM, 2000). While computers and graphing calculators often come to mind when thinking about the use of technology in the classroom, a more recent addition has been the interactive white board (IWB). IWBs are whiteboards that are connected to a computer and allow the teacher and students to interact with the board by manipulating images on the screen with a touch of the finger or pen stylus. Many people refer to these as “Smart Boards,” but IWB is a more appropriate general term, since SMART is simply one of many companies that produce this type of touch-sensitive board. For example, the Promethean Board is a more recent IWB product that was designed specifically for use in the classroom.

Use of IWBs in Ohio Classrooms

Having recognized the rising popularity of using IWBs in the mathematics classroom, I conducted a mini-study to determine how Ohio teachers are using the tool. I used the following data collection methods for the study:

- exchange of emails with two teachers in the eastern part of the state
- email interview with another teacher who has been using IWBs since their inception
- observations of and interviews with a teacher who uses an IWB in her high school mathematics classroom
- interviews with students who have an IWB in their mathematics classroom

Through analysis of the collected data, I recognized several patterns regarding the implementation of IWB and their positive impact on instruction. The first question I asked was “How do you incorporate the IWB into your daily lessons? Do you use it only when necessary or on a regular basis?” All four of the teachers interviewed said they used their board on a daily basis. Teacher A commented “I use SMART Boards in my classroom every minute of every period.” When observing Teacher B’s classroom, I realized how central the IWB was to teaching of her lessons. She explained to me that she uses it every day. She would have a difficult time reverting to using a chalkboard because of the perceived benefits of using an IWB.

The two most popular distributors of IWBs are SMART Technologies and Promethean. There are hundreds of downloadable applets one can use with either type of boards. In addition, both companies have websites that provide teachers with premade lessons they can use in mathematics classrooms. The second question I asked the teachers pertained to downloading applets. I asked the teachers if they downloaded applets from the Internet, or if they tended to create their own. The teachers generally agreed they did not have enough time to search the sites for applets that can be used in their classrooms. Teacher C claimed that he uses the software “to create skeleton lessons to use for instruction on a regular basis.”

Teacher A explained that he uses TI-SmartView from Texas Instruments, which is a graphing calculator emulator. “[Students] can see what buttons I push and what the result is instantaneously. I can also insert screen shots of the calculator screen right into my notes.” I also observed Teacher B using this emulator software in her classroom. Her students were pleased with the full-screen calculator display on the IWB. They noted that they were less likely to get confused when doing calculations. Students also said the teacher was able to freeze the calculator screen and place the screen onto a page. This way, they could easily refer back to the calculation. If a teacher wants to show students answers or graphs on a graphing calculator but does not have an IWB, an overhead projection device can be connected to the calculator to display the screen on the wall. The students are able to see the resulting answer or graph; however, they cannot see the buttons the teacher pushed that allowed them to reach that point. As a result, students may be confused about how to use the calculator, rather than concentrating on the concept or answer being shown. This, in turn, requires teachers to take time out of the lesson to explain which buttons to use. The TI-SmartView software may also allow for teachers to spend more time discussing a mathematical concept, rather than using valuable class time helping students locate buttons on a calculator.

I also asked the teachers what types of activities they regularly use on the IWB. Teacher B explained that she uses a CD, “Calculus in Motion” (Weeks, 2008), containing different dynamic geometry animations intended for use with Geometer’s Sketchpad. With one such animation, the classroom teacher uses an interactive graph to help students visualize the rotation of a function about the axes (see Figure 1).

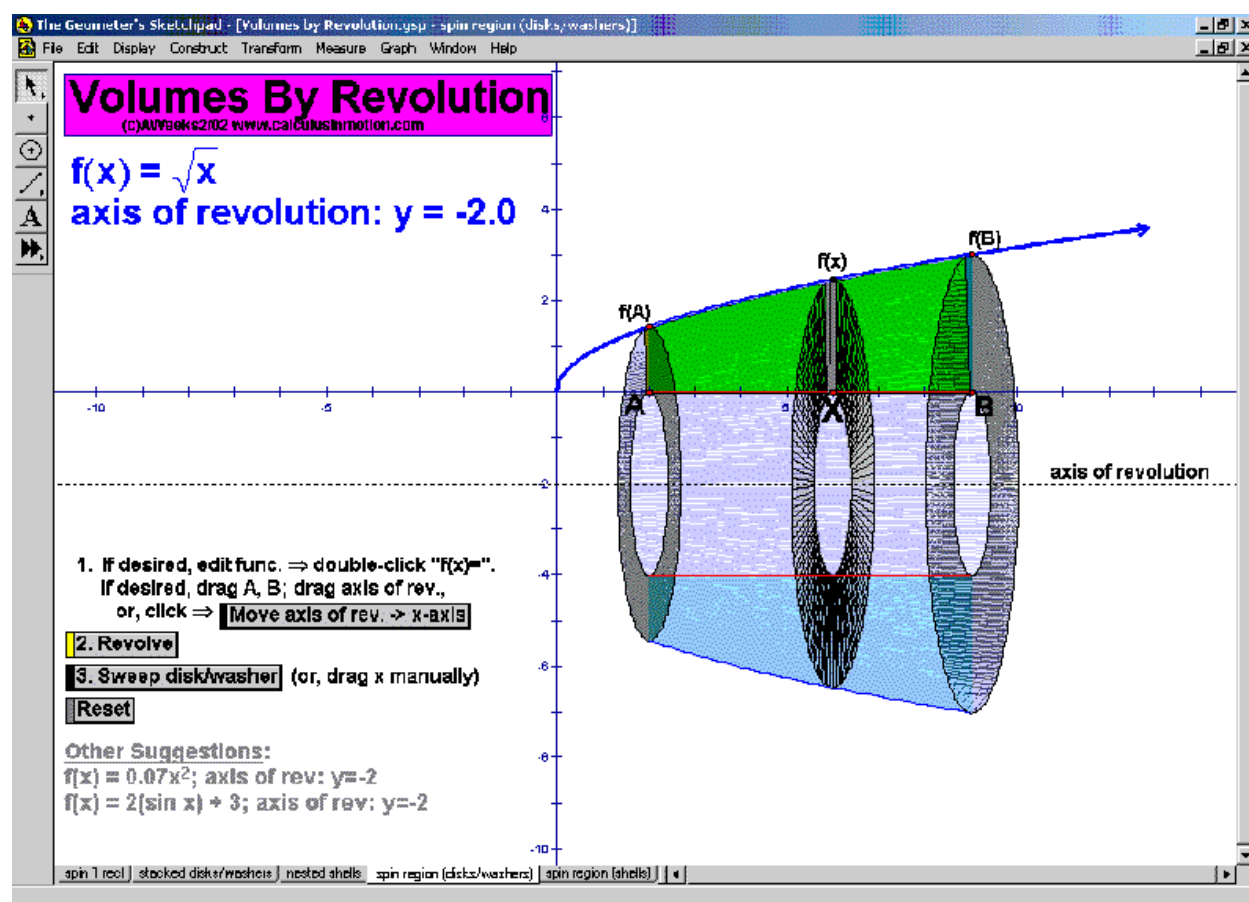


Figure 1: *Calculus in Motion* Example

In the lesson I observed, she also used an interactive graph from the program to find the area between the curves of two functions by calculating the integral. The animation shows the distance between the y-

values of two functions as a line segment. Starting at a point of intersection between the functions (so that the segment is actually a single point), the animation illustrates that as the x -values increase, the area between the graphs of the two functions also increases.

Advantages to Using an IWB

One of the most important questions I asked the teachers was, “What do you do with the IWB that you would not be able to do if you did not have one in the classroom?” The unanimous response to this question was the ability to use colors in order to differentiate concepts. Of course, one could use colored chalk or even colored markers on a regular white board, but Teacher B explained the difference. She noted that when one uses colored markers on a regular white board, the intersection of two functions causes the colors to mix. Students reported that when the teacher uses different colors to help separate problems or functions, it is easier for them to follow the processes or steps involved in solving a problem. With the IWB, it is also possible to move the graph of a function by simply dragging it. This is not possible with a regular board; if you want the function to be moved you must erase the first one and redraw it. By erasing the first one, you are also going to erase part of the other function, in which case you will have to go back and fix it. Therefore, another benefit to using an IWB is one can easily manipulate objects on the screen by moving them off to one side without having to delete and redraw them. Teacher C explained, “Using colors and being able to manipulate drawings and graphs easily is nearly impossible without it.” Some of the students interviewed agreed that the ability to rotate shapes and move objects made learning mathematics easier. They appreciated the fact that all the teacher or student has to do is click and drag on the objects they want to move.



Another key feature of the IWB that emerged in the research is that teachers can easily save the work they did with the students in class to a file on the computer. Teacher D says, “It is so easy to document our discussions and investigations. If I did not have this I would not be able to keep a record of all the things the kids and I do on the board. I honestly think note-keeping alone makes the board invaluable for me.” Both Teacher A and Teacher B save their class notes as PDF files and post them on their class Web sites. The students who are absent that day are responsible for going to the site and getting the notes so when they return to class, they have an idea as to what the class learned the previous day. Students also appreciated the fact that teachers posted the day’s notes online for them to check if they were absent or missed class. This is also helpful for students who have lost one of the pages of notes; they can easily retrieve a complete copy of the notes for that day to prepare for tests or quizzes. Teacher A also explained that, “When I am absent, I prerecord my lesson as a video. In that way, my students do not miss out at all. It is like I am there.” Of course, this practice, in turn, would make it a lot easier on substitute teachers because they could play the video on the computer and stop it if the students have questions. This helps to maintain consistency in teaching styles as well because the students are not being taught by a substitute who may teach concepts differently from what they are used to or may not be a mathematics teacher.

Another feature teachers appreciated about the IWBs is the “undo” button. This allows the teacher to easily erase or reverse something they did not intend to create. Teacher B also commented that by having problems prewritten, it gives her more time to actually do the math and discuss the process, rather than taking the time to write out the problem or draw pictures. As a result she is able to maximize her students’ time on task.

Strengths and Weaknesses

I was also interested to know if the teachers perceived any drawbacks to using the IWB. One of the major issues that emerged is the teacher’s ability to use the board properly. Teacher D answered her district “did not provide training beyond a few-half day in-services, which did not help me to implement the program.” From discussions with these teachers and my advisor, I have discovered that teachers are not always given appropriate training. Due to lack of professional development and out-of-class time, many are

forced to learn how to use the board during class time. This can cause delays in the lesson and results in wasted class time as the teacher tries to figure out how to create a line segment, measure an angle, and so on. Some teachers simply choose not to use the IWB at all due to a lack of understanding of how to implement it in their teaching. Until the teacher has more experience using the board, it takes considerable time before the class runs smoothly.

The students mentioned that they saw some potential disadvantages to having the IWBs in the classroom as well. They noted if a teacher does not know how to use the board, they rarely work it into their lessons. They also pointed out how it makes the lesson longer if a teacher is struggling to figure out how to do things on the board, causing students to lose the focus of the lesson. The students also commented the board only allows one person to be writing on it at a time, so you cannot have multiple people at the board like you can when using chalkboards.

There are other technical issues that may occur, such as a computer freezing (remember that the IWB is only as “smart” as the computer that drives it) or a file not opening. “Technological issues can bog down a lesson greatly and because of the amount of physical space it takes up; other media are sacrificed and thus limited when I must resort to them,” said Teacher C. Since the screen is touch sensitive, you must reorient the screen when it is first turned on. Also, if the projector is bumped, then the screen must be reoriented. This means you have to take your finger or interactive pen and touch each point on the screen so that it can reconfigure to be used properly. One way to eliminate this is to have the projector mounted on the ceiling, as opposed to having it sit on a cart. This helps to reduce the possibility of the projector being bumped and therefore reduces the class time used to reorient the screen – a concern expressed by students. It is also important to back up all of the work done on the computer. Teacher B says that she posts everything as a PDF file on the Internet as well as saves her work onto CD’s and transfers it on her computer at home.

Improvement on Student Learning

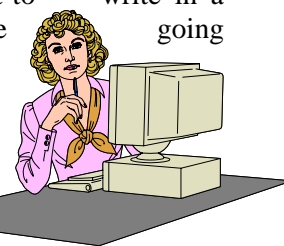
Another vital question that I asked the teachers was, “Do you feel as though students’ comprehension of concepts has increased as a result of using the interactive white board? Why or why not?” This question resulted in mixed answers. Teacher D says, “This remains to be seen. I am not sure – right now the kids are very attentive because the board is new to them and they treat it as if they were using a computer.” Teacher B also says it really depends on the teachers and the subject matter. Even though a teacher may have a teaching tool that could enhance their classroom, it will not necessarily change that individual’s teaching ability. Teacher B also believes the IWB definitely helps when using visuals such as rotation of functions about the axes. She said she used to tape cardboard to the chalkboard to try to show her students what it would look like to rotate a function around the x -axis. She says with the new software, it is much easier for the students to get the full effect.

On the other hand, Teacher C is more positive about an increase of comprehension: “I definitely feel their comprehension of abstract ideas has increased because while such things are discussed and attempted to be shown via other media, the [IWB] does so much more because of interactive capabilities.” Teacher C does not cite any specific statistics to show an increase of comprehension, but Teacher A does. “Absolutely. [Students] have told me so. I also have my AP Calculus scores. Last year I had eleven 5’s, five 4’s, a 3 and a 2. Those scores are way above the national average. I really believe it has a lot to do with how I employ the [IWB] and its software.” This last sentence is key, because it is similar to the point that Teacher B was trying to make when she said it really depends on the teacher.

Intimidation Factor

As a mathematics education major, I have begun to realize that many students are “afraid” of math in the sense that if they do not understand it, their solution is to reject it. I thought that having an IWB in the classroom may make learning math more enjoyable, and also help to alleviate some of the students’ fears

of math. I asked the teachers, “Do you believe that there are other aspects being influenced such as students’ confidence in coming to the board and solving problems, less anxiety about learning new, more challenging material, and having a more positive approach to learning math?” There were mixed comments to this question. Teacher D explained that, even though she is somewhat protective of the board because students can sometimes be rough with it, they “love to present using the board.” Teacher C tends to disagree. “There is less anxiety with the challenging material because some of it is more easily seen on the [IWB]. Perhaps there is more anxiety in actually coming to the [IWB] to use it because some are intimidated by it.” Teacher C may be referring to the same intimidation factor that students have always faced when coming to the board. Students do not want to risk the humiliation of being wrong in front of their peers, and despite the “coolness” of the new boards, students may still be fearful or intimidated. Teacher B agrees that students are still afraid of making mistakes at the board and also, “students do not feel comfortable because of their sloppy handwriting.” It is difficult to write in a way that allows for neat handwriting on the IWBs, so students do not feel comfortable going to the board. Teacher A indicated that he does not send his students to the board at all.



I also asked the teachers whether “the IWBs are changing the way students feel about learning math, and is this positive or negative?” Teacher D had much to say on this topic. “Many students do not like math – their parents don’t like it and no one likes the practice that at times is necessary and usually found in the form of homework. The kids love the board. I think part of their attachment to the board is that sometimes it makes me seem more like a student, because I make some mistakes operating the board.” Despite the fact that she does not elaborate as to how the students’ attitudes towards math have changed positively, she did confirm that initially many students do not like math. She also admits that she is like a student when using the board due to little training, therefore causing her to make mistakes in front of the class. This characteristic makes her appear to be more human and thus maybe even more approachable, resulting in a very positive change.

Teachers A and C both commented that they, too, see a positive change. Teacher B says that to the students, the board looks more exciting than a chalkboard or a regular white board. Students want to volunteer in her classroom to come to the board and use it. She also gets the sense that since she is excited about the board and what she can do with it, her students are also excited. A teacher’s attitude toward the subject matter can have a major effect on the student’s attitude toward the subject matter.

Student-Centered Classrooms

Research supports the idea that – or – the fact that students’ understanding of mathematics is stronger in student-centered classrooms, as opposed to lecture-based classes. Therefore, I wondered if the use of the IWB promoted a more constructivist classroom environment. So, I asked the teachers, “Since you are using an IWB, have you tried to change your methodology so that the lessons are more student-oriented instead of lecture based?” Teacher D responded by saying that, “The students I see are not accustomed to this investigative process in math but are moving toward more student driven activities and studies.” Teacher C agrees that as a result of having the board, students are becoming more actively involved. “I’ve been able to make the lessons more student-oriented in that they’re making more predictions, as well as being more creative because they can rely on this visual modality that might not otherwise be possible.” Teacher B claims she has students who are willing to come to the board and fill out her skeleton lessons she has created on the board. It is as if the student is teaching the rest of the students, and she is there to clarify the concepts.

One concern that was expressed about using the IWBs is students may be too impressed by the “wow” factor of the board to even remember the point of the lesson. I asked the teachers if they are “finding that students are remembering the lesson based upon the activity but not remembering the actual concept?” Teacher C explained, “I don’t necessarily think students are lacking in conceptual understanding. The

activities are still ‘on the board’ much of the time; they’re just more easily manipulated and more quickly oriented, reoriented, and reconfigured for better student understanding than would be possible with a piece of chalk.” When asking students their thoughts on the usage of the IWB, they seemed to be very excited to talk about it. I could sense that there was some sort of “wow” factor contributing to their excitement. The students were excited by this new technology and seemed eager to personally use and discuss it. The students’ responses seemed unanimous: “It makes learning so much easier, especially in mathematics and science.” Students commented they could tell some teachers enjoy using the IWB more than others. As a result, students have more fun learning due to the teacher’s positive energy. Students also commented they felt comfortable going to the board. They found themselves more engaged in class activities.

Future Research

Current literature indicates there is no solid research evidence to show that use of an IWB results in higher achievement levels compared to the use of a chalkboard, overhead projector, or dry erase board. One reason why there is not much research on the effectiveness of IWBs in the classroom is the relative newness of the technology. SMART created the first board in 1991, but it was originally used exclusively for business purposes (SMART Technologies Inc., 2008). It was not until recently that we started seeing IWBs in the classroom. Consequently, I have three suggestions for conducting a study to determine the effectiveness of an IWB in the classroom:

1. A comparative study could be conducted with two groups of students. Each group would be made up of students sharing the same demographics and learning abilities to be consistent. One group would be taught using a chalkboard or overhead; this would be the control group. The second group would be taught using an IWB. Each group would be taught the same material, use the same examples, and be assigned the same homework, quizzes and tests. At the end of the study, achievement of the two classes could be compared to determine what effect, if any, the board had on the students.
2. Another recommended study would be to observe a teacher before and after obtaining a board in the classroom. By observing the same teacher over time, the researcher would be able to determine how the teacher’s lessons change as a result of having this new technological tool. Student attitudes and achievement levels could also be compared over the same time period. In this case, the researcher would be looking for differences in teaching style, if any. Perhaps the teacher would use more computer math programs, online interactive applets, or refer to Web sites with video clips. The researcher might find that the teacher has changed his/her lesson plans to include online activities for students to interact with so that the students would have a better understanding of the underlying mathematical concepts.
3. Another way to determine the effects of IWBs is to compare student achievement on standardized or advanced-placement tests. The researcher would need to identify two groups of students sharing similar demographics; one group of students would be taught using an IWB and the other group of students would not. Ideally, the same teacher (or two teachers with similar styles) would work with both groups of students.

Conclusion

Using an IWB, teachers can have lessons prewritten and saved so they do not have to utilize class time for drawing graphs or writing down new sample problems. Teachers can also use color to help differentiate between multiple concepts, problems, and solutions. The use of an IWB also allows teachers to draw more accurate graphs, diagrams, and polygons as well as to readily drag and move the images as needed. Using the Internet, a teacher can have students go to the board and experiment with online applets that may enhance student learning and comprehension. Along with delivery benefits, teachers can save the day’s work to their computer or a USB drive for later use.

The IWB may change the way that one teaches a class; it could become a more student-centered classroom or a more lecture-style classroom. Many may view the IWB as having a student centered, motivational effect on the class since students can go to the board and explore with applets online or use other computer programs to manipulate problem scenarios. The IWB allows students to have more resources at their fingertips to help them develop conceptual understanding. However, the IWB may also have the opposite effect if a teacher finds it easier to instruct the students, so they simply lecture at the IWB, as they might have done at a chalkboard or white board.

Until further research is completed to determine whether an IWB has a significant effect on student achievement, it cannot be said that these boards are essential to the teaching profession. The board may have many positive features, but as with all new technology, there are still kinks that need to be worked out. Technology is always changing; as soon as everyone has invested in the newest technology available, something better has been created and placed on the market. The IWB may not even be in existence in fifty years, but at present, some believe it is among some of the best technologies being used for teaching mathematics in Ohio.

References

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The advertisement features a large, stylized logo for "MATH Trailblazers" at the top left, with "MATH" in a blocky font and "Trailblazers" in a script font. Below the logo is the tagline "A BALANCED MATHEMATICS PROGRAM INTEGRATING SCIENCE AND LANGUAGE ARTS". To the right of the logo is a circular seal that says "K-5 NSF-Funded". Below the logo, the text "Creating Confidence in a Competitive World" is written in a bold, italicized font. Underneath this, a paragraph states: "Being able to think critically, solve problems and communicate confidently are essential skills in an increasingly competitive world. Math Trailblazers delivers the tools your teachers expect and the foundation your students need to be successful and confident in school and in life." To the right of this text is a photograph of a young boy in a white shirt and tie, holding a pencil to his chin and smiling. Below the photograph, the text "CONFIDENT Teachers. CONFIDENT Students." is written in a bold, italicized font. At the bottom left, there is a box with the text: "To see what's new in the 3rd edition and request your free grade level sampler, go to www.mathtrailblazers.com or call 800-542-6657." At the bottom right, the Kendall Hunt logo is displayed, consisting of a stylized "K" inside a square followed by the name "Kendall Hunt".

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